

# Mariner Venus/Mercury 1973 Mission Support

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*During January and February 1973, DSN preparations for Mariner Venus/Mercury 1973 mission support included continuing implementation of new capabilities, initiation of training, test and operations planning, and revision of plans to match new budget guidelines. The DSN Progress Review was held on February 2, 1973 to evaluate the progress of these ongoing activities. Much of the information in this article stems from Progress Review material.*

## I. Planning Activities

### A. NASA Support Plan

NASA Headquarters approval of the NASA Support Plan (NSP) was expected prior to January 1, 1973. However, this approval has been delayed until the effects of recent budget reductions on NSP commitments are clear. We have requested that review and approval be completed prior to the next Mariner Venus/Mercury 1973 (MVM 73) Quarterly Review on March 29 and 30, 1973.

### B. DSN Preparation Plan

The DSN Preparation Plan for MVM 73 (JPL internal document 615-105, Jan. 15, 1973) was approved, published, and distributed during this reporting period. The implementation plans contained in this document served as a basis for evaluating the status presented during the DSN Progress Review.

### C. DSN Operations Plan

Preparation of the Network Operations Plan for MVM 73 is on schedule. A draft of the document, including ground communications and Deep Space Station (DSS) portions, was completed during this reporting period. The approved version is scheduled for completion in March 1973 as a prerequisite to start of DSN testing for MVM 73 in April 1973.

### D. DSN Support Team

The DSN Support Team for MVM 73 has continued to meet twice each month to resolve open items in the areas of DSN/Mission Control and Computing Center (MCCC)/Project interface requirements and design. All significant action items have been completed with results published in appropriate documentation. Therefore, it is anticipated that the DSN Support Team will be discon-

tinued at the end of February 1973 in favor of a DSN Test/Operations Support Team headed by the Network Operations Planning Engineer.

### **E. Mission Sequence Planning Support**

The Network Operations Organization has been involved in supporting the Mission Sequence Working Group in design of the MVM 73 mission. Sequences have been reviewed for consistency with Network operational capabilities. The Network Operations Manager has served on the Mission Sequence Design Review Board. Network operations people attend the working group meetings and have made presentations on Deep Space Station prepass and hand-over procedures. Work has been initiated to define DSS track time allocations in support of the sequence and to resolve MVM 73/Pioneer 10 encounter schedule conflicts.

## **II. Program Control**

### **A. Interface Control Document**

The MVM 73 Spacecraft/Mission Operations System/Tracking and Data System/Mission Control and Computing Center System Interface Control Document (ICD) is in work. However, all DSN portions of this document have been completed and approved by the appropriate cognizant engineers for tracking, telemetry, command, simulation, monitor, and radio frequency systems. The ICD forms the baseline for interface configuration and change control. Any changes that would alter the approved interface require joint approval of the interfacing agencies prior to implementation. Maintenance of interface integrity for the DSN side of these interfaces is the responsibility of the DSN Change Control Board.

### **B. DSN Progress Review**

Validation and evaluation of DSN plans and progress for MVM 73 is accomplished through a series of reviews as set forth in the DSN Support Requirements Document for MVM 73. The DSN Progress Review is one in the series that leads to operational readiness; see Table 1.

The DSN Progress Review was conducted on February 2, 1973. The purpose was to: (1) review status of DSN development and implementation tasks, (2) review detailed DSN test and training plans, (3) review the status of DSN/Spacecraft compatibility test plans and test results, (4) verify that DSN preparations are following the plans, and (5) identify open areas and assign actions for resolution.

The Review Committee was cochaired by the DSN Implementation Manager and the DSN Operations Manager. Other Committee members included the TDS Manager, DSN Manager, and Project people representing the areas of data processing, flight operations, and spacecraft telecommunications. The Review was conducted in accordance with the agenda shown in Table 2. The named presenters are the cognizant development engineers for DSN implementation and the cognizant operations engineers for test and training activities. Summaries of information presented are included in the appropriate paragraphs of Sections III and IV of this article.

Following the presentations, the Review Committee met to consolidate comments, define problem areas, and assign action items. A complete package of the review material was prepared and distributed to all participants and attendees. Results of assigned action items will be addressed in future articles.

## **III. Implementation Activities**

### **A. GCF Status**

The presentation was made by the cognizant development engineer using GCF level-6 implementation schedules and configuration diagrams as a basis for discussion. Basically, GCF implementation is on schedule. Circuits between JPL and Boeing, Kent, are operational. GCF engineers are fully cognizant of and are accommodating recent changes in requirements and plans. Completion of the 28.5 kbps and 230 kbps wideband data line implementation is expected to continue on schedule. Inability of the NASA Communications Network (NASCOM) to provide training for NASCOM-furnished wide-band data line (WBDL) equipment in February/March 1973 may cause difficulty, but work-arounds will be designed. The high level of activity associated with coded multiplexer delivery and installation is a critically tight schedule to be closely monitored.

### **B. DSS Status**

DSS implementation status was given by cognizant hardware/software development engineers using task summaries and schedules as a basis for discussion. Most implementation is targeted toward an April 1, 1973 completion for start of DSS/DSN test activities. Notable planned exceptions are: DSSs 43 and 63, planetary ranging, and DSS 14 S-band/X-band (S/X) implementation. Many problems discussed have to do with implementation that appears to be from one to two months later than

required for test activities and readiness commitments. Consequently, many action items assigned require additional detailed schedule review between the Network Operations Project Engineer (NOPE)/Cognizant Operations Engineers (COEs) and Cognizant Design Engineers (CDEs).

**1. Telemetry and Command Data Subsystem software and hardware.** Telemetry and Command Data Subsystem (TCD) software development is on schedule. Integration of all modules shall be completed in early February 1973 through loading of all program elements. Included are TCD executive, command, TCP telemetry, and Data Decoder Assembly (DDA) telemetry elements. Stand-alone verification tests for all modules are completed. In regard to hardware, the dual high density recorder assemblies are on schedule. However, the Symbol Synchronizer Assembly (SSA)-DDA coupler modification appears to be one month late to support start of tests. Also, DSS time must be scheduled for the modification installation.

**2. Digital Instrumentation Subsystem.** Digital Instrumentation Subsystem (DIS) hardware and software development for monitor purposes is on schedule. There appear to be no problems to completing implementation on the required 1 April date. DIS implementation to provide high-speed tracking capabilities extends well beyond April 1, 1973 for some DSSs. This was not unexpected. For some time we have recognized that replacement of teletypewriter (TTY) by high-speed data line (HSDL) for transmission of radio metric data might occur late in our planned test period at certain DSSs. However, implementation at some DSSs must be completed by April/May to permit early verification of the tracking system design and performance.

**3. Simulation Conversion Assembly hardware and software.** Installation of Simulation Conversion Assembly (SCA) modifications at some DSSs extends into May 1973. Stations that start testing in April 1973 require an operational SCA. Also, DSS time must be scheduled for modification installations.

**4. Planetary ranging hardware and software.** Planetary ranging is committed to be operational on October 1, 1973 at DSS 14 and on January 1, 1974 at DSSs 43 and 63. Also, it is desirable that this capability be available at CTA 21 in July 1973 or at DSS 71 in September/October 1973 for RF compatibility testing. The hardware schedule presented shows that subsystem testing will be completed on or later than the committed dates. Completion of system tests and operational status would push this well

beyond the needed dates. Software schedules appear to be consistent with need dates.

**5. S/X-band experiment.** Modification of the feed cone assemblies was completed and reinstallation on the DSS 14 antenna and testing were accomplished between January 22 and 30, 1973 as scheduled. Included are the ellipsoidal reflector over the S-band feed and a dichroic mirror over the X-band feed with each feed mounted in separate cone structures. The dichroic mirror passes the X-band signal and reflects the S-band signal. Preliminary test results show that the electrical performance is excellent: no S-band degradation and less than 0.2 dB degradation at X-band due to the dichroic plate. No warping problems were observed in the plate during thermal testing at a power of 300 kW. It was planned that DSS 14 S/X-band capabilities would be completed for operations in an R&D mode by October 1, 1973. S/X-band RF compatibility tests with an S/X-band transponder and DSS 14 Block IV receiver were planned for June/July 1973. Late installation of the coherent reference generator, Block IV receiver, and S/X ranging is not compatible with this plan.

**6. DSSs 43 and 63.** DSS 43 implementation is on schedule for a July 1, 1973 completion and start of testing for MVM 73 as planned. DSS 63 has encountered problems and is projecting a September 1, 1973 completion date rather than the planned July 1, 1973. The October 1, 1973 readiness date for MVM 73 appears to be in jeopardy unless system tests are permitted to begin earlier than September 1, 1973. The geodetic survey for DSS 63 is completed and DSS 43 is in work.

## IV. Test and Training Activities

The DSN/Spacecraft Compatibility Test Plan (JPL internal document 615-115, Feb. 12, 1973) has been approved and published. During the coordination of this plan, it became clear that spacecraft, DSN, and mission operations tests required during the spacecraft thermal-vacuum period could not be accommodated in a serial manner during the time available. A working group has been established to design a test program that meets requirements through combining compatible test objectives into integrated tests.

Flight spacecraft No. 2 subsystems/DSN compatibility tests were completed in January 1973 as scheduled. All planned tests were completed and no anomalies were observed. All tests passed established acceptance criteria. Included were radio frequency, command, and functional telemetry tests.

Training of the DSN Operations Control Team (OCT) for MVM 73 was initiated during this reporting period. Classroom training, consisting of presentations by mission operations and DSN operations planning people, is about 50% completed. Pertinent lectures have been videotaped. These tapes will be used for continued training of DSN operations people including one-site training at the Deep Space Stations.

Recent reorganizations within the DSN have consolidated planning, engineering, and operations functions. This has resulted in significant changes in the way the DSN accomplishes implementation, testing, and operational readiness. Revised test phases, responsibilities, and milestones are illustrated in Fig. 1. DSN testing for MVM 73 will be conducted in accordance with the provisions set forth in this new plan as illustrated in Fig. 2.

**Table 1. DSN reviews for MVM 73**

Review	Date
DSN Functional Design	December 1971
Telemetry/Command Data Software Functional Design	June 1972
DSN Detailed Design	July 1972
Telemetry/Command Data Software Detailed Design	October 1972
DSN Progress	February 1973
Telemetry/Command Data Software Verification Test	March 1973
DSN Operational Readiness	August 1973
Project Launch Readiness	October 1973

**Table 2. DSN Progress Review for MVM 73—introduction and agenda**

Topic	Speaker
Introduction	E. K. Davis
Purpose	
Agenda	
Review committee	
DSN development/implementation status	
GCF status	R. H. Evans
Wideband data line (28.5 KBPS)	
Wideband data line (230 KBPS)	
RIC circuits	
DSS status	
TCD software/hardware	J. H. Wilcher/ R. Mancini
DIS monitor	R. N. Flanders
DIS high-speed tracking	R. N. Flanders/ J. R. Smith
SCA—hardware and software	R. N. Flanders
Planetary ranging	J. R. Smith
S/X-band	R. L. Weber
DSS 43 and 63	R. C. Rydgig
DSN test/training status	
Test sequence	C. W. Harris
Test matrix	
Test definition	
Test plan	C. W. Harris
Schedule overview	
Scoe activities/status	
Detailed test schedule	I. L. Emig
Training activities	T. M. Taylor
Requirements	
Plan	
Schedule	
Problem areas	C. W. Harris
DSN-spacecraft compatibility test status	
Test plan	E. K. Davis
Current status	
Key features	
Open areas	
Quick-look test report summary	W. L. Brown
Flight No. 1 subsystem tests	
Flight No. 2 subsystem tests	
Problem areas	
Committee discussion	
Review comments	
Identify and assign action items	

		NEW CAPABILITY TESTING (MULTIMISSION TESTS)				MISSION PREPARATION TESTING (SINGLE MISSION TESTS)				
TEST ↓ FUNCTION		FIRST MODEL DEMONSTRATION (HW ASSY OR SW MODULES)	FIRST STATION SUBSYSTEM ON-SITE ACCEPTANCE TEST	UNIT BY UNIT ACCEPTANCE TEST (HW ONLY)	SUBSYSTEM ON-SITE ACCEPTANCE TEST	SYSTEM PERFORMANCE DEMONSTRATION	MISSION CONFIGURATION TEST (SYSTEM LEVEL)	OPERATIONAL VERIFICATION TEST	PERFORMANCE DEMONSTRATION TEST	CONFIGURATION VERIFICATION TEST
COORDINATING AUTHORITY		430 SUBSYSTEM ENGINEER	430 SUBSYSTEM ENGINEER 33 PROJECT ENGINEER	430 SUBSYSTEM ENGINEER	430 SUBSYSTEM ENGINEER 33 PROJECT ENGINEER	430 SYSTEM ENGINEER	430 DSN MANAGER FOR PROJECT X	421 NOPE		
TEST REQUIREMENTS/ ACCEPTANCE CRITERIA		430 SUBSYSTEM ENGINEERS	430 SUBSYSTEM ENGINEERS	422 SUBSYSTEM COE	422 SUBSYSTEM COE 421 SW COE	430 SYSTEM ENGINEERS	430 DSN MANAGER FOR PROJECT X	421 NOPE	421 NOPE	421 NOPE
PROCEDURES		33 CDE	33 CDE	33 CDE	422 SUBSYSTEM COE 421 SW COE	421 SCOE	421 NOPE	421 NOPE	421 NOPE	421 NOPE
TEST CONDUCT		33 CDE	33 CDE	33 CDE	422 SUBSYSTEM COE 421 SW COE	421 SCOE	421 NOPE	421 NOPE	421 NOPE	421 NOPE
TEST REPORT		33 CDE	33 CDE	33 CDE	422 SUBSYSTEM COE 421 SW COE	421 SCOE	421 NOPE	421 NOPE	421 NOPE	421 NOPE
PERFORMANCE EVALUATION		430 SUBSYSTEM ENGINEERS	430 SUBSYSTEM ENGINEERS 430 SSE 421 SW COE	422 SUBSYSTEM COE	422 FACILITY OPERATIONS MANAGER	430 SYSTEM ENGINEERS, AND 421 NETWORK OPERATIONS MANAGER	430 DSN MANAGER FOR PROJECT X	421 SUPERVISOR OCT	421 NETWORK OPERATIONS MANAGER, AND 430 DSN MANAGER FOR PROJECT X	420 DSN OPERATIONS MANAGER
SUBSEQUENT EVENT		AGREEMENT BY 430 SSE ON PROCEEDING TO FIRST STATION S/S/ASSY DEMO	AGREEMENT ON PROCEEDING TO NETWORK INSTALLATION	33 CDE TRANSFER TO FACILITY OPERATIONS (422) SUBSYSTEM COE	422 S/S COE TRANSFER TO STATION DIRECTOR * 421 SW COE TRANSFER TO STATION * DIRECTOR	FACILITIES PLACED UNDER CONFIGURATION CONTROL FOR APPROPRIATE MISSIONS AND RETURNED TO OPERATIONAL STATUS	TECHNICAL PERFORMANCE DEMONSTRATION	FACILITY PROFICIENCY DEMONSTRATION	NOPE TRANSFER MD CONFIGURATIONS TO OCT; MOS TESTS	CONFIGURATION FREEZE
MILESTONE NAME		SUBSYSTEM/ASSEMBLY FIRST UNIT DEMONSTRATION SW ASSY DIV 33 CDE TO 421 SW COE TRANSFER SUBSYSTEM/HW ASSY DIV 33 CDE TO 422 SUBSYSTEM COE TRANSFER			SUBSYSTEM IMPLEMENTATION COMPLETE	NETWORK SYSTEM PERFORMANCE DEMONSTRATION MISSION CONFIGURATION COMPLETE DSN OPERATIONAL READINESS				
MILESTONE SYMBOL		FIRST UNIT DEMO ▲ SOFTWARE TRANSFER ○								

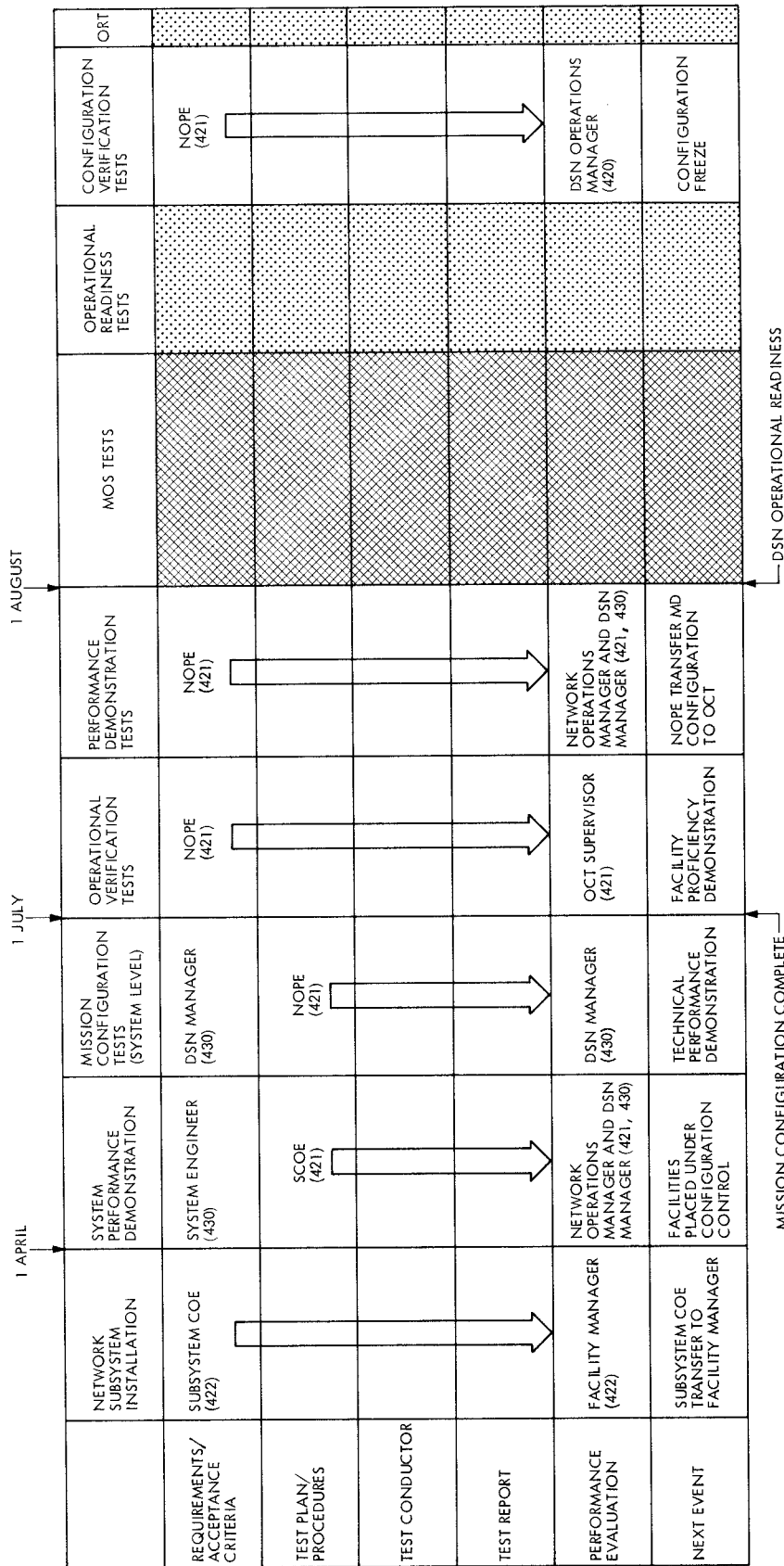
LEGEND

XXXX	TEST RESPONSIBILITY FOR HARDWARE
XXXX	TEST RESPONSIBILITY FOR SOFTWARE
XXX	TEST RESPONSIBILITY INDEPENDENT OF HARDWARE VERSUS SOFTWARE

*	OR GCF AND/OR NCS EQUIVALENT
SSE	SUBSYSTEM ENGINEER
CDE	COGNIZANT DESIGN ENGINEER
COE	COGNIZANT OPERATIONS ENGINEER
SCOE	SYSTEM COGNIZANT OPERATIONS ENGINEER

NOPE	NETWORK OPERATIONS PROJECT ENGINEER
OCT	OPERATIONS CONTROL TEAM
MOS	MISSION OPERATIONS SYSTEM
33, 430, 422, ETC	= DIVISION OR SECTION/ORGANIZATION No.

Fig. 1. Relation of tests, responsibilities, and milestones



OCT = OPERATIONS CONTROL TEAM  
COE = COGNIZANT OPERATIONS ENGINEER

SCOPE = SYSTEM COGNIZANT OPERATIONS ENGINEER  
NOPE = NETWORK OPERATIONS PROJECT ENGINEER

**Fig. 2. Mission preparation text matrix (420 responsibility)**